we have not found vertical upward velocities so great as those given above, although horizontal eastward velocities amounting to more than 50 m./sec. are not uncommon, and the values of ψ_z are proportional to this.

Hence it seems that generally, at least in the southern part of the cyclone, where westerly winds blow in all the strata, the vertical upward velocity that would be produced by ψ_z and thus indirectly by these strong westerly winds, is greater than the one really observed. Now the observed velocity is produced jointly by ψ_z, the vertical pressure gradient ε, and the friction (which latter may be neglected); and thus it follows that ε must be negative.

This remarkable result may be expressed in the following manner: A part of the *vis viva* of the westerly winds prevailing in the cyclone is used in pumping the air up, by means of ψ_z, against the mean vertical temperature gradient ε, which tends to make it descend.

Now Prof. Hann has shown (19) that the mean temperature of the air column in the inflowing winds of a cyclone is generally so much lower than that of an anticyclone, that the vertical temperature gradient of the former must probably be directed downward. This result, although deduced from incontestable facts, has called forth much criticism, as the incontestable fact of an upward motion in cyclones seemed then inexplicable. Hann himself has pointed out that the mechanical energy (*vis viva*) of the upper current may be able to pump up the air of the cyclone against the pressure gradient. I believe that I have now shown how this transformation takes place. Of course, there may be modes of transformation other than the above, but this evidently will accomplish much. As to the *vis viva* of the upper currents of the cyclone, it may originate partly from the general atmospheric circulation, and partly from the mechanical energy produced by the cyclone itself from the latent heat of aqueous vapor. The proportion between these two sources of energy is probably quite variable.

There is another observed fact, which is explained by the action of ψ_z. Clement Ley and Hildebrandsson have observed that the cirrus clouds are much more numerous in westerly upper currents than in easterly. Now, since ψ_z is directed upward in the former and downward in the latter, the air will generally rise in a westerly current and thereby be cooled, so that the aqueous vapor contained in it will be condensed and form the ice needles of which the cirri consist. The reverse will take place in an easterly current.

The vertically deviating component ψ_z will also have a marked influence on the propagation of the cyclone center. Considering the well-known diagrams of Clement Ley and Hildebrandsson, we find that all strata, upper and lower, have a westward component of horizontal velocity in the northwest quadrant of the cyclone, but in no other. Thus the currents of all strata in this quadrant will have a downward acceleration (ψ_z negative) which after a time will give a downward velocity. This will reach its maximum somewhere to the west of the center, in the rear of the cyclone; then the currents entering the southwest quadrant will acquire an eastward component of horizontal velocity, which will give rise to an upward acceleration (ψ_z positive), by which the downward velocity acquired in the northwest quadrant will be gradually diminished and will vanish somewhere in the southern part of the cyclone. It therefore follows that the air will tend to sink down in the western half of the cyclone and that the reverse will happen in the eastern half. Obviously this will contribute to fill up the western part and empty the eastern part of the cyclone, so as to displace the center eastward.

Certainly the propagation of a cyclone is a very complicated phenomenon which may have many coöperating causes, but I think the cause above named is in most cases a very efficacious one that may not be neglected.

REFERENCES AND NOTES.

(1) Partly extracted from the memoir: "Über die Einwirkung der ablenkende Kraft der Erdrotation auf die Luftbewegung." Bihang till K. Svenska Vetensk.-Akad. Handl., Bd. 15, Afd. 1, No. 14. Stockholm, 1890.

(2) The cause of the general trade-winds. Phil. trans., London, 1735.

(3) Mémoire sur les équations du mouvement relatif des systémes de corps. Jour., École polytechnique, t. **15**, cahier 24, p. 142.

(4) Motions of fluids relative to the earth's surface. *Mathematical* monthly (Runkle), 1859; and then in Ferrel's well-known "Researches."

(5) Études sur les mouvements de l'atmosphère. Christiania, 1876 and 1880.

(6) Traité de méchanique rationelle, par M. Ch. Delaunay. 2me. éd., Paris, 1857. p. 94. (*I have not seen the first edition of this treatise.*) The proof is reproduced in "Cours de mécanique" par M. Despérioux, etc. Avec des Notes par M. G. Darboux. t. 1. Paris 1884. p. 176 ffg. Also in Schell's "Theorie der Bewegung und der Kräfte" there is a geometrical proof of Coriolis' theorem, which is clear and rigid but rather long.

(7) Sprung. Lehrbuch der Meteorologie. Hamburg. 1885. p. 16.

(8) The proof is quite general; only for the sake of perspicacity we refer the position of the mobile immediately to the earth.

(9) Instead of these we may use the geographical latitude and the mean radius of the earth, without introducing any sensible error.

(10) Sprung. Lehrbuch der Meteorologie. p. 80–81.

(11) This is evident since then v is perpendicular to the equator.

(12) Because ω is equal to the quotient of 2π by a siderial day expressed in seconds of mean time $\omega = 2\pi / 86\,164.09^{\text{sec.}} = 0.00\,007\,292\,1$.

(13) *See* Sprung's Lehrbuch. p. 16.

(14) Études sur les mouvements de 'atmosphère. Christiania, 1876, and Ztschr. d. Gesellsch. f. Meteorol., Wien, 1877, **12**:**53**.

(15) Meteorologische Zeitschrift, Wien, 1888, **5**. Jhrg., p. 329.

(16) These measurements number more than 2,000. Although calculated some years previous to 1893 they have not yet been published in extenso, partly for want of time and partly for other reasons.

(17) This is according to Jordan, "Handbuch der Vermessungskunde," Stuttgart, 1877. 1. Bd., p. 532. Bauernfeind's inquiries furnish for a difference of height of 1 km. a mean error of ±5.7 meters in the difference when determined barometrically. This, if due to a vertical gradient, would require a gradient of about 50 mm., which is obviously impossible.

For the rest, it would evidently require very exact barometric observations to determine even a horizontal gradient in so short a distance as 1 km.

(18) The second integral, $t - t_0 = \frac{1}{c}$ nat. log $\frac{z}{z_0}$, gives the time necessary for the vertical movement from z_0 to z. If $z_0 = 0$, it becomes infinite, which is rational, as we have supposed both acceleration and velocity equal to 0 at the ground ($z = 0$).

(19) *See* Meteorologische Zeitschrift, Wien, 1890, **7**. Jhrg. p. 226, 328, 457.

METEOROLOGY AT THE LICK OBSERVATORY.[1]

By WILLIAM GARDNER REED.

[Dated, University of California, Department of Geography, June 10, 1914.]

INTRODUCTION.

The Lick Observatory was founded under two deeds of trust by James Lick of San Francisco, the first dated July 16, 1874, and the second, September 21, 1875. These provided for "a powerful telescope, * * * and also a suitable observatory connected therewith." After a careful consideration of various possible sites (restricted to the State of California by the terms of the trust), the choice was Mount Hamilton, lat. 37° 20′ north, long. 121° 38′ west from Greenwich, altitude,[2] 4,209 feet above sea level, located among the Coast Ranges in the eastern

[1] The writer wishes to thank the members of the staff of the observatory, without whose cooperation and assistance this study could not have been made, and in particular to thank Director W. W. Campbell for the meteorological data, the photographs, and numerous other courtesies at the observatory.

part of Santa Clara County. The general location of the mountain and the larger topographic features of the region are best studied with the aid of the U. S. Topographic Atlas sheets for California. The topography of the region is shown in detail on the Mount Hamilton, Cal., sheet of the Topographic Atlas of the U. S. published by U. S. Geological Survey. The buildings are located on "Observatory Peak," the third of the highest peaks of the mountain, while on the higher peaks are placed the reservoirs for the water supply and hydraulic power. The general relations are shown by figure 3, a photograph of the observatory from Copernicus Peak, northeast of the observatory, and one of the two highest peaks of the mountain. An act of Congress, approved June 7, 1886, granted the trustees somewhat more than two sections of Government land including the summit of the mountain; later James Lick and Robert F. Morrow gave the trustees about 190 acres more, "so that the Observatory is secured forever against buildings in close proximity to it." The deed of trust provided that when the telescope and the observatory were completed they together with the land, should be conveyed to the Regents of the University of California, the corporation to which the government of the State University is entrusted. Any surplus of the $700,000 provided for the construction and equipment of the telescope and the observatory was to be turned over to the university and the income devoted to the maintenance of the observatory. The observatory was to be known as the Lick Astronomical Department of the University of California.

The actual work on Mount Hamilton began in the summer of 1880, and the regular astronomical work of the completed observatory on July 1, 1888. Since then the observatory has been in continuous operation. It is significant that the first volume issued from the observatory contains the following: "The Observatory is not primarily destined for a meteorological station. Its very exceptional situation, however, creates a responsibility on its part to engage to some extent in making routine meteorological observations, and a suitable outfit for this purpose has been obtained."[3] The results of the observations have been published from time to time by the Astronomical Society of the Pacific. A considerable volume was compiled by Astronomer C. D. Perrine, but not published for lacks of funds. Great credit is due many members of the staff and especially Dr. Perrine for the excellent condition of the record.

METEOROLOGICAL OBSERVATIONS.

Although the regular astronomical work of the observatory did not commence until July 1, 1888, meteorological observations have been made on Mount Hamilton since September 11, 1880. During the period of construction the observations were necessarily limited by the "other and more important occupation" of construction. However, the record during this time is surprisingly complete, chiefly because of the interest of Thomas E. Fraser, the superintendent of construction, by whom they were almost entirely made. Table 1 shows the observations made on Mount Hamilton for which the record is now available. Unfortunately the observing hours from November 9, 1885, to June 30, 1888, were not stated; no records are available for certain months, as will be seen from the table.

From July 3, 1888, meteorological observations were made at 7 a. m., 2 p. m., and 9 p. m. until September 30, 1908. Since October 1, 1908, observations have been made at 8 a. m. and 8 p. m., Pacific standard time. These observations have included pressure from a mercurial barometer, wet- and dry-bulb temperatures, wind direction and force on the Hazen scale (until Sept. 30, 1903), amount of cloud and occurrence of fog, both on the mountain and in the valleys. At the 2 p. m. and later at the 8 a. m. observations dial readings of the anemometer have been made; at the 9 p. m. and later at the 8 p. m. observations the maximum and minimum temperatures have been recorded and the self-registering thermometers set. Continuous autographic records of pressure, precipitation, and wind movement since 1888, and of air temperature since 1890 are also available.

The regular voluntary (cooperative) observer's reports have been sent to the Signal Service and the Weather Bureau. They have been printed in the climatological publications of those services. Summarized data have been published in United States Weather Bureau bulletins "L" and "W," and also by Director Holden, Dr. Perrine, and Dr. Maddrill, of the observatory staff, in the Publications of the Astronomical Society of the Pacific. The record from September 11, 1880, to October 31, 1885, was printed in full in the Publications of the Lick Observatory, Volume I.

INSTRUMENTS AND INSTRUMENTAL RECORDS.

The meteorological instruments were installed at the observatory in 1884 and 1885. These instruments included:

A Draper self-recording (weighing) mercurial barograph, magnifying five times.

A Draper self-recording (weighing) rain gage.

Two mercurial barometers, one by J. and H. J. Green of the Fortin cistern type, large bore (0.55 inch) tube, and one by John Roach, type not stated.

Eleven exposed thermometers, two maximum thermometers, and three minimum thermometers, all by Green; of these one minimum and two exposed were furnished by the Signal Service; the others were compared and certified by Yale College.

An anemometer of the United States Weather Bureau pattern, reading by dial to miles of wind travel (ratio, cup travel : wind travel :: 1 : 3) and recording electrically on a Weather Bureau type of "single register."[4]

The record of instruments used during the period of construction is far from complete. The type of thermometer in use before 1885 is not stated. In 1885 and 1886 a number of "standard" thermometers were furnished by Green; the Winchester Observatory of Yale College compared these with a standard. No record is available of the method of determining relative humidity, which was first recorded in 1886. It is probable, however, that the relative humidity was at that time obtained from wet- and dry-bulb readings according to the method then in use by the Signal Service.

[2] Altitude determined in 1887 under the direction of W. G. Raymond of the Department of Civil Engineering of the University of California as 4,209.42 feet to a bench on the marble floor of the observatory, by levels from the Market Street Station of the Southern Pacific Railroad in San Jose (elevation 88.7 feet, assumed). See Publ. Ast. Soc. Pacific, vol. 3 (1891) p. 370.

The altitude is stated by the United States Coast and Geodetic Survey as 1,298.9 meters (4,262 feet) on top of the 12" dome. ". . . the height of the small [12"] dome above the marble floor of the Lick Observatory is stated to be 40 feet 4 inches (12.3 meters); hence the height of the marble floor is 1,286.6 meters or 4,221 feet." See U. S. C. & G. S., Special Publication No. 4 (1900) "The Transcontinental Triangulation," by Charles A. Schott. This elevation is stated in "Triangulation in California, Part II," Appendix 5 of the Annual Report of the Superintendent for 1910, as belonging to class 3 "those [elevations] determined by nonreciprocal zenith distance measures, in which the probable error may be as much, in some cases, as ±10 meters." U. S. C. & G. S. Ann. Rept. for 1910 (1911) p. 308.

The altitude is stated in "A Dictionary of Altitudes in the United States" on the authority of the United States Geological Survey as 4,209 feet. U. S. G. S. Bull. 274 (1906) p. 96.

The altitude of the Southern Pacific track at San Jose is stated in U. S. G. S. Bull. 274, p. 124, on the authority of the U. S. C. & G. S. as 118 feet. The altitude of the base of the rail is stated on the present railroad profile as 98.91 feet above the mean sea level datum of the U. S. Geological Survey.

[3] Publications of the Lick Observatory of the University of California, 1887, vol. 1, pt. 9. Description of the Meteorological Instruments, by E. S. Holden, p. 78.

[4] For a more complete description of these instruments and their exposures see Publ. Lick Obs. Univ. Calif., 1887, vol. 1, pt. 9, pp. 78-81.

FIG. 1.—General view of Lick Observatory, on Observatory Peak of Mount Hamilton, Cal., from Copernicus Peak to the northeast. (Photo. by C. A. Bergmann, Apr. 2, 1914.)

FIG. 2.—Meridian Circle House (Lick Observatory) from the northwest. Note the louvred construction of the walls.

Thermometers are exposed in the double wall beyond the first window. The whirling device for the wet- and dry-bulb thermometers is between the observing slit and the second window.

The anemometer has occupied the position shown here since May 27, 1891; the wind vane since July 5, 1893. (Photo. by C. A. Bergmann, May 29, 1914.)

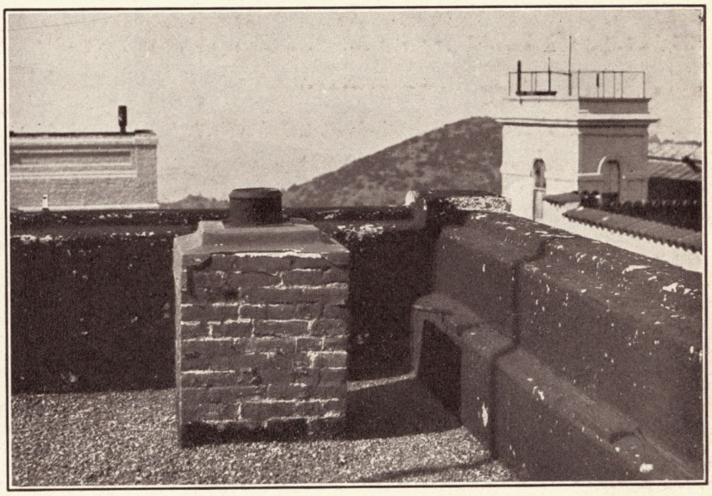

FIG. 3.—Details of rain gage exposure on the roof of Lick Observatory, 33 feet above the ground. The recording apparatus is immediately below. (Photo. by C. A. Bergmann, May 29, 1914.)

TABLE 1.—*Schedule of Meteorological Observations at the Lick Observatory.*

Dates.	Pressure.	Temperature. Daily.		Temperature.	Relative Humidity.	Precipitation.	Wind. Velocity.	Wind. Movement.	Wind. Direction.	Weather.
Sept. 11, 1880, to Sept. 26, 1880		Max	Min						Daily	Daily.
Sept. 27, 1880, to Dec. 1, 1880	Daily	Max	Min						Daily	Daily.
Dec. 2, 1880, to Dec. 21, 1880	6 p.m.	Max	Min			Daily			6 p.m.	Daily.
Dec. 22, 1880, to June 12, 1881	6 p.m.	Max	Min			Daily				Daily.
June 13, 1881, to Feb. 28, 1882	6 p.m.	Max	Min			Daily			6 p.m.	Daily.
Mar. 1, 1882, to June 30, 1882		Max	Min			Daily			6 p.m.	Daily.
July 1, 1882, to July 11, 1882	6 p.m.	Max	Min			Daily			6 p.m.	Daily.
July 12, 1882, to Aug. 31, 1882	6 p.m.	Max	Min			Daily				Daily.
Sept. 1, 1882, to July 16, 1884	6 p.m.	Max	Min			Daily			6 p.m.	Daily.
July 17, 1884, to Sept. 30, 1884	6 p.m.	Max	Min			Daily				Daily.
Oct. 1, 1884, to Nov. 8, 1885	6 p.m.	Max	Min			Daily			6 p.m.	Daily.
Nov. 9, 1885, to Feb. 8, 1886	(No record)									
Feb. 9, 1886, to July 30, 1886	Twice Daily.	Max	Min			Monthly			Daily	Daily.
July 31, 1886, to Sept. 30, 1886	(No record)									
Oct. 1, 1886, to Feb. 5, 1887	Daily	Max	Min	6 p.m?	6 p.m?	Daily	Daily max	Daily	Daily	Daily.
Feb. 6, 1887, to Apr. 4, 1887	Daily	Max	Min	6 p.m?	6 p.m?	Daily			Daily	Daily.
Apr. 4, 1887, to June 30, 1887	Daily	Max	Min	6 p.m?	6 p.m?	Daily	Daily max	Daily	Daily	Daily.
July 1, 1887, to July 31, 1887	(No record)					Total				
Aug. 1, 1887, to Aug. 17, 1887	Daily	Max	Min	6 p.m?	6 p.m?		Daily max	Daily	Daily	Daily.
Aug. 17, 1887, to Sept. 30, 1887	Daily	Max	Min	6 p.m?	6 p.m?	Daily			Daily	Daily.
Oct. 1, 1887, to Dec. 29, 1887	Daily	Max	Min	6 p.m?	6 p.m?	Daily	Daily max	Daily	Daily	Daily.
Dec. 30, 1887, to Jan. 31, 1888	Daily	Max	Min	6 p.m?	6 p.m?	Daily			Daily	Daily.
Feb. 1, 1888, to May 31, 1888	Daily	Max	Min	6 p.m?	6 p.m?	Daily	Daily max	Daily	Daily	Daily.
June 1, 1888, to June 30, 1888	Daily	Max	Min	6 p.m?	6 p.m?	Daily	[1]		Daily	Daily.
July 1, 1888, to Sept. 30, 1908	7^a, 2^p, 9^p	Max	Min	7^a, 2^p, 9^p	7^a, 2^p, 9^a	Noon	Daily max	Daily	7^a, 2^p, 9^p	Daily.
Oct. 1, 1908, to date	8^a, 8^p	Max	Min	8^a, 8^p	8^p, 8^p	Noon	Daily max	Daily	8^a, 8^p	Daily.

[1] May 27, 1891, the anemometer was lowered 10 feet to its present position on the Meridian circle house.

Atmospheric pressure.

Pressure was observed by means of an aneroid barometer until July 1, 1888, when the thrice-daily observations with the mercurial barometer began. In 1886 the correction for the aneroid was +0.21 inch, but the record does not show that this correction was applied. Since 1888 the pressure readings have been made from mercurial barometer No. 2839 Green. This instrument has a large-bore tube (0.55 inch inside); the scale is graduated in twentieths of inches to read directly to the argument of the Pulkova refraction tables by a vernier to 0.005 inch. The record had been entered originally to scale numbers, but converted to inches and thousandths to May, 1906. The pressures are available for each observation.

The barometer has been exposed, from the first, on the inner north wall of the Meridian Circle House; its location is shown by A in figure 4. The instrument hangs about 1½ inches from the wall and is held in a vertical position by a shelf around the cistern. The cistern is 4,212 feet above sea level (assuming the elevation of the marble floor is 4,209 feet). The readings and averages that have been issued from the observatory have been corrected for the temperature of the mercury only. The walls of the Meridian Circle House are double, the inner is of solid redwood and the outer of louvers of galvanized iron (see fig. 2). The space between the two walls is about 2 feet.[5] There is an ample chamber or attic over the observing room and the building is well ventilated, so that the inside temperature is the same as that of the outside air; the building is never heated artificially, and warming by solar radiation is prevented by the construction.[6] The Roach barometer was not at the observatory in 1902, and seems never to have been used for meteorological observations.

[5] For a more complete description of the Meridian Circle House *see* Publications of the Lick Observatory, 1900, 4:5.

[6] A series of comparisons made by R. T. Crawford in June and July, 1899, showed an average difference of temperature in the space between the walls and inside the Meridian Circle House of +0.03° and a maximum difference of +1.1°; in a series in October and November, 1899, the maximum difference was +2.1°, except for one difference of −3.7° at a time when the outside temperature was rising rapidly. *See* Publ. Lick Obs. Univ. Calif. 1913, 7:163–165.

A continuous record of pressure has been kept since July 5, 1888, by the Draper weighing mercurial barograph, magnifying five times. This instrument consists of a barometer tube supported at the top, with its lower open end dipping into a cistern hung on spiral springs. With a decrease of pressure mercury flows from the tube into the cistern, increases its weight, and stretches the springs; a pen attached to the cistern records on a moving sheet of paper behind the barometer. The record sheet is changed daily at noon. No correction for the temperature of the mercury need be applied to the readings of this barograph, as the weight of the mercury and not the length of the column is recorded. The correction for change in the springs with temperature is small enough to be negligible. The barograph is exposed opposite the rain-gage on the south wall of the east vestibule of the observatory (see D in fig. 4). The top of the mercury in the cistern is usually at about the same elevation above sea level as the fiducial point of the Green barometer in the Meridian Circle House.

Air temperature.

From September 11, 1880, until September 30, 1885, the thermometers were exposed in a wooden box at one of the cottages some 70 feet below the observatory and about 200 yards to the northeast. The records of temperature before and after October 1, 1885, are, therefore, not strictly comparable.[7] Since October 1, 1885, the exposure has been between the north walls of the Meridian Circle House about 7 feet above the ground. The location of the instruments is shown by B in figure 4, and the outside of the Meridian Circle House and the character of the ventilation by figure 2. Until September 30, 1908, there were exposed here maximum and minimum thermometers (Weather Bureau type) and wet- and dry-bulb thermometers forming a *stationary* psychrometer. Since October 1, 1908, wet-bulb readings have been made from a whirled thermometer under conditions which are discussed below. Both spherical- and cylindrical-bulb ther-

[7] *See* Perrine, C. D., in Publ. astrons. soc. Pacific, 1893, 7:124.

mometers have been used on the psychrometer, but no record is available of the service of each type, and there seems to have been an irregular succession of the two types as thermometers were broken in service.

Continuous records of temperature have been obtained from Richard seven-day thermographs since November 21, 1893, when a standard size (B. C. M.) instrument, reading from +5° to +100° F. was exposed with the mercurial thermometers. The record sheets have been changed on Mondays at noon. There a few thermograms for the year 1890 and continuous records from August 31, 1893, to November 21, 1893, but the exposure of the instrument during this time is not stated. This thermograph was compared with the exposed thermometer

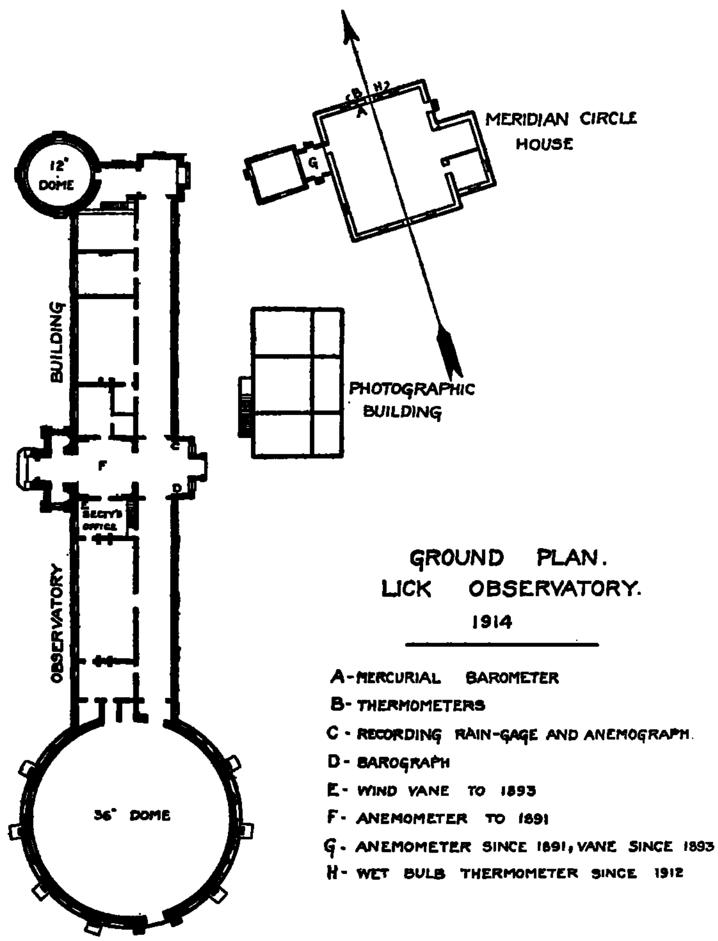

FIG. 4.—Plan of Lick Observatory, showing locations of meteorological instruments at various periods since September 11, 1880.

in September and October, 1894; the resulting corrections show the usual irregularity of the recording instrument but no correction was over three degrees and the average of all comparisons was less than half a degree. This thermograph continued in service until April 12, 1909. On March 1, 1909, a Richard thermograph, large size, reading from −25° to +115° F. was placed in service with the thermometers. This instrument is the property of the U. S. Weather Bureau; it has continued in service since its installation, and is now (1914) exposed with other thermometers between the walls of the Meridian Circle House.

Daily maximum and minimum temperatures have been observed since the first record (by Mr. Fraser), which included the maximum and minimum temperatures for September 11, 1880. The thermometers were exposed in a wooden box on the "flat" about 70 feet below and 200 yards northeast of Observatory Peak until October, 1885, when they were moved to their present location in the space between the walls of the Meridian Circle House. The ventilation of the early exposure in the wooden box was probably not as good as could be desired. Since October 1, 1885, the exposure has not been changed. Before June 30, 1888, maximum and minimum readings were usually made at 6 p. m., although there are some records of other times of observation. From July 1, 1888, until November 30, 1889, these observations were made at noon in Table 5, and an attempt has been made to adjust the maximum to the proper civil date by recording it as of the previous date. Since July 6, 1889, maximum and minimum readings have been made at the evening observation hour and the date regarded as the civil date on which the observations were made. The manner in which the readings were adjusted to the two times of observation and the time at which the instruments were set during the period of two records, noon and 9 p. m., are not stated in the record.

The early record does not state the type of thermometers used to obtain maximum and minimum temperatures, but it is probable that they were of the usual Signal Service pattern. Since the beginning of observations in the Meridian Circle House the self-registering instruments of the Signal Service and Weather Bureau type have been in service. When an observation was missed the maximum and minimum temperatures have sometimes been interpolated from the thermograph trace, but the record is clear on all occasions where this has been done.

Atmospheric moisture.

Relative humidities for the observation hours have been computed since October 1, 1886, and are available. Until July 3, 1888, there is no record of the type of instrument used: but, as the stationary psychrometer (wet and dry bulb thermometers) depending on natural ventilation was in service at the beginning of the regular astronomical observations in 1888, there is little doubt that this was the type of instrument employed. From July 3, 1888, wet- and dry-bulb readings have been made at the regular observation hours. Until September 30, 1908, the readings were still made from a stationary psychrometer, exposed between the north walls of the Meridian Circle House (see fig. 2 and B in fig. 4). From October 1, 1908, wet-bulb readings were made from a sling thermometer usually inside the Meridian Circle House, which, as already stated, is practically a large instrument shelter. This method was continued until March 12, 1912.[8]

Since May 9, 1912, psychrometer readings have been made with thermometers mounted on a Weather Bureau whirling apparatus located between the outer and inner north walls of the Meridian Circle House (see H in fig. 4 and fig. 6), about 10 feet east from the other thermometers. During most of this period the wet and dry bulb thermometers have both been mounted on the whirling apparatus, but at times dry-bulb readings have been made from the stationary dry-bulb in its original location (B in fig. 4). Since September 30, 1903, relative humidity has

[8] No record can be found of the date on which the use of the sling thermometer was discontinued, but the original record of observations shows a period of 42 days, beginning March 12, 1912, during which no wet-bulb readings were made. After May 9, 1912, fewer wet-bulb thermometers were broken, indicating a less dangerous method of ventilation (whirling apparatus). The recollection of the members of the observatory staff is that the change to the whirling apparatus was made about this time.

usually not been computed, although the observation of the wet-bulb thermometer has been continued and recorded at each observation hour; it is possible, therefore, to compute humidities, as all the observations are available.

A Weather Bureau hair-hygrograph by Friez, standard size, was placed in service March 1, 1909; since then there has been a continuous record of relative humidity from this instrument and the records are now on file at the Observatory. The record sheets are changed Mondays at noon. The hygrograph is exposed with the thermometers, and the thermograph between the north walls of the Meridian Circle House (see B in fig. 4).

The dew point was regularly computed from wet and dry bulb readings between July 3, 1888, and September 30, 1903; since that time the computations have not been made although the wet- and dry-bulb temperatures are available so that computations may be made; the dew points since March, 1909, may be computed from the hygrograph record.

Precipitation.

Rainfall and melted snow has been measured by the Draper self-recording rain-gage. The receiving funnel of the gage is exposed on the roof of the observatory over the east vestibule. (See fig. 4, C, and fig. 3.) The rim of the funnel is a circle 7⅝ inches in diameter; it is 3 feet above the roof and about 2 feet from the northeast corner of the parapet, which rises 2 feet 8 inches above the roof; figure 3 shows the relations between the gage, the roof, and the parapet. The rim of the funnel is 33 feet above the ground and 4,239 feet above sea level.

The recording apparatus is immediately below the funnel, on the north wall of the vestibule. (See C in fig. 4.) This consists of a bucket carried on spiral springs; an ink pencil attached to the bucket makes a trace along the zero line at the top of the record sheet when the bucket is empty. Precipitation falling into the funnel is carried by a tube to the bucket below; the funnel is warmed by the office below and also by a lamp (now a 32-candlepower carbon electric lamp) which is kept burning during snowfall so that such snow as is caught by the funnel is melted and flows into the bucket. As water flows into the bucket the springs are extended and the recording pen is carried down the sheet until the 0.50-inch mark at the bottom of the sheet is reached; at this point the weight of the water in the bucket is sufficient to overcome its stability, the bucket automatically empties by tipping, and is then carried up by the springs until the pen again reaches the top of the record sheet. An adjustable weight is attached to the bucket and so placed that the tip occurs at the instant when the 0.50-inch mark is reached. After the bucket rises to the top of the record sheet, the water continues to flow in and the record of the next 0.50 inch is made in the same manner as the first. The record sheets are changed daily at noon, the same sheet being used repeatedly unless it has a record of precipitation. Only the sheets which have records of precipitation are filed, but a record is kept of days with rain so there is no doubt that the record is complete for the period since 1888.

During the period of construction a rain gage of unknown type was used; this gage was placed in service December 2, 1880. The precipitation for November, 1880, was estimated at half an inch at the time and appears as such in Table 3. There is no record of the time at which the observations from the Draper gage began; apparently the gage was in place early in 1886, but the first record sheet in the file is dated September 30, 1888. The daily report shows that this was the second rain of the rainfall year beginning July 1, 1888; 0.02 inch fell on August 29, 30, and 31. There are no records of stick measurements of rainfall, the amounts from the record sheets being reported to the Signal Service and, later, to the Weather Bureau.

Records of snowfall and of snow on the ground are imperfect. Because of the exposed position of the observatory, snowfall measurements here are of very doubtful value. The relation between the amount of snow caught by the funnel of the rain gage and the actual snowfall has not been determined and such determination will be exceedingly difficult. The recorded precipitation includes the water-equivalent of the snow caught by the funnel as this snow is at once melted and flows to the recording bucket. The questions of loss by evaporation during melting and of loss in the tube have never been studied here; but both these losses are probably a small percentage of the necessary loss, due to wind during precipitation.

Wind direction.

During the period of construction the general wind direction for the day was at first estimated. With the beginning of the thrice-daily observations in July, 1888, and probably since 1885, wind direction was observed by means of a vane about 11 feet long with a Weather Bureau type of head but a single board tail measuring about 5½ feet long by 11 inches wide. This vane was mounted on a staff about 20 feet high, located directly over the Secretary's office. (See E in fig. 4.) On July 5, 1893, the vane was moved to the northeast corner of the tower by the Meridian Circle House; this location is shown by G in figure 4 and in figure 2. The new exposure probably gives the true direction of the wind more nearly than the old. The vane is mounted on a staff 7 feet in height, making the vane 42 feet above the ground and 4,248 feet above sea level, referred to the bench on the marble floor of the observatory. The daily wind directions reported to the Weather Bureau have usually been computed from the records of wind direction at the observation hours.

Wind velocity.

Wind velocity has been recorded from dial readings of a Robinson cup-anemometer of the Signal Service pattern (arms about 7 inches to the centers of the cups). The anemometer was mounted on a staff about 20 feet high, above the roof over the central portion of the observatory until May 27, 1891. Its then position with relation to the building is shown by F in figure 4. The cups were 50 feet above the ground and 4,256 feet above the sea-level plane to which the bench mark on the marble floor refers. Since May 27, 1891, the exposure has been over the tower by the Meridian Circle House on a staff about 5 feet long. This exposure is shown by G in figure 4, also by figures 2 and 3. The cups are 40 feet above the ground and 4,246 feet above sea level. The present exposure is probably good for all directions except the southeast, the direction from which the strongest winds generally come. Comparisons between the exposure over the observatory and that over the tower (points F and G in fig. 4), made in January, 1895, when the wind was almost continuously from the southeast, indicate that the recorded velocities of the southeasterly winds are considerably lower than the indicated velocities from the old exposure. The recorded velocities of southeasterly winds are also lower than the recorded velocities of winds of the same apparent force from other directions.

All records of wind velocity are those recorded directly from the cup travel by the fixed ratio of the instrument (3:1) indicated by the dial as miles of wind movement. No attempt has been made to correct the dial readings to the true wind movement and velocity. In addition to the dial readings, wind travel has been recorded electrically on a Signal Service pattern anemograph ("single register"); this register is located just west of the recording device of the rain gage in the vestibule of the Observatory (C in fig. 4). The anemometer and the single register were installed in 1884,[9] but the file of record sheets at present at the observatory begins with July 1, 1888. Records of dial readings and total indicated wind travel begin October 1, 1886, and, except for periods when the anemometer was out of service because of ice or other hindrances, are continuous from that date. Originally the circuit to the single register was closed at every mile of indicated wind travel (one-third mile of cup travel) and a record made on the sheet. On June 7, 1889, some of the contact pins were cut off, so that the circuit was closed and the record on the sheet marked every fifth mile of indicated wind travel.

NONINSTRUMENTAL OBSERVATIONS.

A record of wind velocity on the Hazen scale is available for the observation hours from July, 1888, to September, 1903, in addition to the instrumental record of wind movement.

The amount of cloud in tenths of the sky has been estimated at each observation hour since July 3, 1888; the occurrence of fog in the valleys below has also been recorded. Before July, 1888, there are occasional notes of the occurrence of fog, but no regular record seems to have been kept. The general character of the day has been reported from the record of the regular observations, but there is no record aside from the regular observation hours.

Records of occasional phenomena have also been entered from time to time on the reports and are recorded in the observation books. The completeness of these records has, however, varied widely with the individual observers. The necessities of the astronomical work of the observatory, which is its main business, have prevented a complete record except at the observation hours.

OBSERVERS.

The actual observations have been made for the most part by the members of the astronomical staff since July 1, 1888; before that time they were made chiefly by Mr. Thomas E. Fraser, the superintendent of construction. A full list of the observers, with the periods of their services will appear in a future publication of the observatory.

METEOROLOGICAL CONSTANTS OF THE STATION.

Table 2 shows in summarized form the principal changes, with dates, in the constants of the station. The instruments in service May 30, 1914, are listed in Table 2, which also states the instruments now on the property list of the Weather Bureau as loaned to the Director of the Lick Observatory. All elevations above sea level depend upon the value, 4,209.46 feet, adopted as the altitude of the bench mark on the marble floor of the observatory.

TABLE 2.—*Meteorological instruments in service May 30, 1914, at Lick Observatory, Mount Hamilton, Cal.*

[ϕ=37° 20′ N; λ=121° 38′ W. H=4212 ft.; h_t=7 ft.; h_r=33 ft.; H_r=4239 ft.; H_a=4246 ft.; h_a=40 ft.]

Instrument.	Pattern.	Number.	Maker.
Mercurial barometer	Fortin cistern, 0.55-inch bore	2839	Green.
Barograph	Draper weighing mercurial		Draper.
Dry-bulb thermometer	Spherical bulb, Signal Service	24154	Green.
Wet-bulb thermometer *	Cylindrical bulb, Weather Bureau.	5975	Do.
Whirling apparatus*	Weather Bureau		Friez.
Maximum thermometer	do	888	Green.
Minimum thermometer	do	8915	Do.
Thermograph *	Richard, large size	8990	Richard.
Hygrograph	Weather Bureau	14	Friez.
Rain-gage	Draper self-recording (weighing)		Draper.
Wind vane	11-foot, flat tail		
Anemometer	Signal Service		
Anemograph	Signal Service single register		Hahl.

* Property of the United States Weather Bureau.

PRECIPITATION AND TEMPERATURE OF MOUNT HAMILTON.

The monthly, seasonal, and annual rainfall of Mount Hamilton since the beginning of the record is shown by Table 3. The data are those observed by the observatory, but the results have been checked by the records of the United States Weather Bureau and all differences investigated by reference to the original observations. The only important differences are to be found in certain winter months where snowfall was indicated in the reports sent to the Weather Bureau at the date of the fall, but the catch of the rain gage, including melted snow, reported by storms only. In Table 3 the catch of the rain gage has been reported in all cases; this includes rain, melted snow, and precipitation from clouds surrounding the observatory which might be classed as fog at times; the record is that of the total registered catch of the rain gage and in most cases is probably under rather than over the actual precipitation owing to the exposed location of the gage.

TABLE 3.—*Monthly, seasonal, and annual precipitation at Lick Observatory, Mount Hamilton, Cal. (Inches.)*

[H_r=4,239 ft.; h_r=33 ft.]

Season.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	Seasonal.	Year.	Annual.
1880–81	0	0	0	0	0.50	9.68	3.51	5.99	1.13	0.98	0.09	0.33	22.21	1881	23.09
1881–82	0	0	0.10	0.33	0.91	9.72	3.55	2.90	5.40	4.70	0.48	1.06	29.15	1882	29.63
1882–83	0	0	0	6.16	3.45	1.93	3.10	3.75	8.66	2.66	7.55	0	37.26	1883	32.05
1883–84	0	0	0.65	2.15	1.48	2.05	5.60	12.76	16.35	11.96	1.24	3.85	58.09	1884	90.12
1884–85	0	0.15	0.65	3.71	0.01	33.84	1.99	0.57	1.15	2.08	0.16	0.36	44.67	1885	18.23
1885–86	0	0	0.15	0.05	1.92	9.80	4.44	1.80	5.77	6.79	0.70	0	31.42	1886	25.26
1886–87	0	0	0	0.60	2.82	2.34	2.83	7.80	1.39	5.75	0.25	0.30	24.08	1887	30.93
1887–88	0.04	0	0.33	0.09	0.90	11.25	10.04	1.38	3.40	0.68	1.25	0.67	30.03	1888	25.46
1888–89	0	0.02	0.49	0.03	3.27	4.23	1.04	1.42	6.17	1.92	3.21	0.05	21.85	1889	35.84
1889–90	0	0	0	4.38	4.46	13.19	7.93	6.60	4.39	1.79	2.42	0	45.16	1890	29.92
1890–91	0	0	0.80	0.02	0.58	5.39	1.38	7.12	4.10	3.08	1.01	0.57	24.05	1891	28.07
1891–92	0	0	0.28	0.61	0.38	9.54	1.97	2.99	5.98	1.90	3.52	0.32	27.49	1892	34.16
1892–93	0	T.	0.24	1.38	10.30	5.56	3.29	3.45	8.99	3.61	0.95	0.16	37.93	1893	29.18
1893–94	0	0	0.48	0.66	4.01	3.58	9.74	10.52	2.54	0.89	2.78	0.64	35.84	1894	44.49
1894–95	0.02	T.	1.64	2.98	0.84	11.90	10.00	3.08	1.46	2.30	2.39	0	36.61	1895	25.72
1895–96	0.01	0	0.08	0.78	2.46	3.16	9.54	1.08	3.83	6.70	2.10	0.02	29.76	1896	36.64
1896–97	T.	0.28	0.47	1.85	5.86	4.91	3.50	7.42	6.45	0.82	0.28	0.38	32.22	1897	24.38
1897–98	0	0	0.07	1.25	1.51	2.70	2.30	4.16	2.04	0.84	2.41	0.38	17.66	1898	17.11
1898–99	0	0	0.29	1.33	1.23	2.13	5.63	0.75	11.11	1.40	1.47	0.39	25.73	1899	36.32
1899–00	0	0.12	T.	6.37	4.92	4.16	3.26	1.70	3.37	4.06	1.35	T.	29.31	1900	27.30
1900–01	0.01	0.02	0.08	3.48	7.76	2.21	5.76	5.92	1.98	3.33	1.07	0.02	31.64	1901	25.90
1901–02	0	0.05	1.08	2.19	2.89	1.61	1.44	9.14	5.19	2.61	1.19	0	27.39	1902	27.78
1902–03	0	0	0	2.09	3.01	3.11	8.86	2.20	9.89	1.12	0.05	T.	30.33	1903	31.55

[9] *See* Publications of the Lick Observatory, 1887, 1, pt. 9, p. 80–81.

TABLE 3.—*Monthly, seasonal, and annual precipitation at Lick Observatory, Mount Hamilton, Cal.*—Continued.

Season.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	Seasonal.	Year.	Annual.
1903–04..	0	0	T.	0.37	7.67	1.39	1.98	9.53	8.06	4.38	0.45	0.03	33.86	1904	35.21
1904–05..	T.	0.05	2.33	2.51	2.05	3.84	4.04	3.89	5.91	1.36	2.27	0	28.25	1905	23.04
1905–06..	0	0	0.02	0	3.50	2.05	11.66	5.76	9.72	1.81	3.15	1.15	38.82	1906	45.76
1906–07..	0	T.	0.28	0.05	1.92	10.26	9.81	4.69	12.90	1.14	0.42	0.92	42.39	1907	39.47
1907–08..	T.	0	0.01	1.62	0.18	7.77	5.02	4.26	1.95	0.70	2.39	0.02	23.93	1908	21.30
1908–09..	0	0	0	1.37	2.63	2.96	18.18	9.49	4.05	0.03	0.13	0	38.84	1909	43.11
1909–10..	0	0	0	1.77	2.59	6.87	6.24	3.12	3.28	0.91	0.12	0.07	24.97	1910	17.70
1910–11..	0.04	0	0.25	1.06	0.94	1.77	15.76	4.37	7.00	1.35	0.75	0	33.29	1911	34.12
1911–12..	0	0	0	0.46	1.21	3.22	4.44	0.50	3.96	2.70	1.31	0.44	18.24	1912	20.92
1912–13..	0	0	2.01	0.94	2.34	2.28	5.42	0.48	3.40	0.94	1.60	0.07	19.48	1913	23.46
1913–14..	0.06	0.10	0	0	5.34	6.05	11.57	5.24	1.51	2.01	1.80	.....	.....	.....	.....
Averages	0.01	0.02	0.38	1.55	2.82	6.07	6.03	4.55	5.37	2.62	1.54	0.34	31.30	.....	.....

The temperature data for Mount Hamilton have been compiled in Table 4. The data since July, 1888, have been compared with those published by the Weather Bureau, and are in essential agreement with them; in the few cases of disagreement the data for the months have been computed from the original record and the means derived from the new computation entered in the table; all additions have been made by an adding machine. The averages have been determined from the means entered in the table. The extreme temperatures, presented in Table 5, have been compiled from the original records. Owing to the differences in the exposure conditions the extremes before October 1, 1885, have been separated from those observed since that date. This separation has not been made for the means, as it is probable that the difference between the older means and the true mean temperatures for those months is less than the error they introduce into the averages, and it is desired to show the complete record of the station.

TABLE 4.—*Monthly and seasonal mean temperatures at Lick Observatory, Mount Hamilton, Cal.* (°*F.*)

Season.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Seasonal means.
1880–1881......	.....	.....	65.9	61.6	48.7	43.0	42.5	44.0	46.4	54.6	59.0	62.2	.....
1881–1882......	69.4	66.7	62.2	45.6	38.4	42.8	35.8	35.4	41.7	46.2	63.4	63.2	50.9
1882–1883......	72.5	73.3	68.0	50.6	44.1	47.2	45.2	39.2	51.0	43.6	53.0	67.8	54.6
1883–1884......	74.0	70.0	69.6	50.8	50.0	46.4	46.0	40.0	39.2	43.6	54.4	55.4	53.3
1884–1885......	62.4	72.8	60.6	56.2	52.5	41.0	49.0	47.1	51.9	50.0	57.6	58.8	55.0
1885–1886......	68.4	75.0	66.4	61.5	.....	.....	.....	49.4	41.2	46.6	55.1	65.2	.....
1886–1887......	46.2	.....	.....	51.3	48.3	50.4	43.6	33.0	51.4	46.9	53.8	61.3	.....
1887–1888......	.....	69.0	67.2	59.2	53.4	40.6	35.6	44.6	41.9	54.6	53.8	55.6	.....
1888–1889......	68.8	73.8	72.5	59.4	48.2	46.2	41.1	45.6	46.1	50.3	54.4	68.8	56.3
1889–1890......	72.3	72.6	68.6	53.7	49.9	34.8	30.6	36.6	41.3	48.0	46.6	58.2	51.1
1890–1891......	70.2	70.5	67.4	58.8	56.5	46.6	42.0	35.8	41.4	44.7	52.0	55.7	53.4
1891–1892......	71.4	72.6	60.7	59.1	52.1	35.8	44.1	42.4	42.6	42.8	52.6	57.2	52.8
1892–1893......	67.0	71.9	63.4	54.8	51.8	42.1	51.3	39.9	37.2	41.0	51.6	58.8	52.6
1893–1894......	67.9	71.8	55.4	51.0	46.9	44.8	35.9	35.6	40.4	49.4	51.6	52.6	50.3
1894–1895......	71.3	71.6	63.5	55.5	57.6	37.2	36.4	45.6	42.8	47.2	52.2	65.2	53.8
1895–1896......	67.2	70.4	59.0	59.9	47.9	41.4	45.2	46.5	43.4	37.6	46.6	64.6	52.5
1896–1897......	73.2	67.8	61.7	57.8	44.8	45.4	41.5	36.3	32.8	51.0	58.0	57.8	52.2
1897–1898......	70.8	71.5	60.4	51.7	46.3	43.0	35.8	42.8	39.1	50.8	47.9	62.0	51.8
1898–1899......	71.4	71.2	61.8	56.0	46.5	43.1	42.5	41.0	39.6	47.6	46.3	63.7	52.6
1899–1900......	71.6	61.3	69.8	52.7	46.9	45.6	47.5	43.0	48.1	43.0	52.8	63.8	53.8
1900–1901......	71.6	62.0	56.2	57.2	51.0	47.2	39.7	40.4	44.0	44.8	50.1	59.8	52.0
1901–1902......	69.9	69.4	58.8	56.5	50.4	46.6	40.9	39.0	36.6	41.3	46.4	58.4	51.2
1902–1903......	66.7	66.9	68.2	53.0	41.6	41.8	43.7	34.9	40.0	43.7	54.0	61.6	51.3
1903–1904......	64.0	67.4	63.6	59.8	48.2	47.2	41.4	39.6	38.7	45.6	56.6	65.0	53.2
1904–1905......	66.0	72.4	65.0	55.6	51.0	43.0	43.4	43.1	44.4	47.2	45.9	59.6	53.0
1905–1906......	71.3	70.2	62.2	56.4	46.2	41.6	43.3	43.6	40.2	45.6	48.6	56.4	52.1
1906–1907......	75.2	71.8	63.4	58.6	43.7	42.2	34.2	48.2	37.4	49.2	51.4	57.6	52.7
1907–1908......	67.1	66.4	57.5	54.5	49.6	42.4	40.1	38.9	44.6	50.7	46.9	58.1	51.4
1908–1909......	74.4	70.2	62.8	51.6	50.7	40.6	39.2	36.8	37.4	50.6	51.6	60.6	52.2
1909–1910......	65.7	69.8	64.1	55.3	44.4	38.0	35.6	38.3	47.0	50.9	57.0	57.6	52.0
1910–1911......	70.5	72.0	62.4	58.2	48.0	44.7	38.9	32.9	44.0	44.6	48.4	62.4	52.2
1911–1912......	73.4	66.9	56.0	53.8	48.6	39.0	42.8	43.3	37.3	40.0	51.6	59.2	51.0
1912–1913......	65.5	64.6	60.4	50.1	49.8	40.4	37.6	39.7	41.2	43.8	53.8	55.2	50.2
1913–1914......	67.0	69.5	66.0	58.0	43.8	39.0	39.6	42.8	49.9	45.8	54.6	.....	.....
Averages....	68.9	69.8	63.4	55.5	48.2	42.8	41.0	40.7	42.4	47.2	52.3	60.9	52.5

TABLE 5.—*Extreme temperatures at Lick Observatory, Mount Hamilton, Cal., from Sept. 11, 1880, to May 31, 1914* (°*F.*).

Month.	From September 11, 1880.				From October 1, 1885.			
	Max.	Date.	Min.	Date.	Max.	Date.	Min.	Date.
	°*F.*		°*F.*		°*F.*		°*F.*	
July.......	97	14, 1886	30	3, 1902	97	14, 1886	30	3, 1902
August....	96	17, 1885	34	16, 1902	93	23, 1888	34	16, 1902
September	93	1, 1882	30	25, 1901	91	9, 1888 18, 1913	30	25, 1901
October...	90	12, 1901	28	29, 1901	90	12, 1901	28	29, 1901
November.	88	12, 13, 1892	13	19, 23, 1900	88	12, 13, 1892	13	19, 23, 1900
December.	72	23, 1899 6, 1900	17	25, 1899 20, 1911	72	23, 1899 6, 1900	17	25, 1899 20, 1911
January...	74	6, 1893	6	14, 1888	74	6, 1893	6	14, 1888
February..	74	18, 1893	12	12, 1884	74	18, 1893	13	4, 1899
March.....	80	29, 1881	18	14, 1881	76	26, 1887	19	29, 1897
April......	82	27, 1881	21	13, 1883	80	13, 1888	22	12, 1911
May.......	90	19, 1881	21	1, 1901	88	31, 1910	21	1, 1901
June.......	92	6, 1883	29	3, 1902	90	23, 1895	29	3, 1902
Year.	97	July 14/86	6	Jan. 14/88	97	July 14/86	6	Jan. 14/88

NOTE.—Since October 1, 1885, the exposure has been the same, 7 feet above the ground between the north walls of the Meridian Circle House. Before October 1, 1885, the exposure was in a box in the saddle about 200 yards northeast of Observatory Peak and about 70 feet lower.

CONCLUSION.

The meteorological record at Mount Hamilton has been kept continuously for nearly 34 years; during the last 28½ years the exposure of the instruments, except the anemometer and vane, has been unchanged; and during the last 26 years the administration and the routine have remained unchanged. The record, therefore, furnishes a considerable body of data for a study of the mountain climatology of central California. It is especially fortunate that a regular station of the Weather Bureau is situated at San Jose in the Santa Clara Valley, near the foot of the mountain; there are, consequently, available records of undoubted value for a comparison of the climate of the mountain with that of the valley below. Such a study is now contemplated by the University of California and it is hoped that the results of the study will furnish a better understanding of the climatology of the Coast Range region of this portion of the State than has been possible heretofore.

THE NEGLECT OF ATMOSPHERICS.

The great neglect of the study of the atmosphere, both by students and teachers in universities and colleges, as compared to the study of other subjects that are less important to the human race, is common both to Europe and America. It can only be explained by a recognition of the fact that the study of the atmosphere in general has not yet been pushed to such a degree as to have attained great practical importance in the business interests of the world. We have not yet learned to control the storms or to make detailed, accurate long-range predictions of wind and weather. But the rapid approach of this desirable attainment will be greatly facilitated and indeed absolutely assured, when the study is taken up in earnest from the point of view of the experimental physicist rather than that of merely observational climatology. The mind, the brain, the intellect, not brawn and muscle, are the powers that Man must use in his search for the keys that will open the flood gates of the clouds and the winds.

The rapid progress of our knowledge of the upper atmosphere, experimental work with balloons, the prog-